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PROJECTIONS BY INDIVIDUAL HOST COUNTRY

Brazil

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1985

PROGRAM PLAN FOR BRAZIL

(1985-87 AND 1988-90)

Small Ruminants Collaborative Support Program and
Centro Nacional de Pesquisa de Caprinos, Collaborating

Prepared by the Brazil Project Administration Committee
(BZ-PAC)

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SR-CRSP PROGRAM PLAN FOR BRAZIL 1985-87 and 1988-90^{1/}

1. Analysis of the Present Status of the Brazil Program (Dec. 1984).

The SR-CRSP^{1/} Program Advisory Committee for Brazil (BZ - PAC) met in Sobral during December 1984. The principal investigators (PI's) also had several meetings, including two with the CNPC chief, Dr. Luiz Freire. SR-CRSP documents prepared since the May 1984 TC meeting were considered, as well as the latest developments at the CNPC. The program plan which is presented in the following pages reflects a consensus of the CNPC leadership, the Brazil PI's, and their CNPC collaborators relative to needs and emphasis for the FY85-87 and FY88-90 periods.

A. Has the Brazil Program Reached Graduate Status?

In a discussion of "graduate" status of a research institution-development program, it is necessary to distinguish between the status of the host country and that of the collaborating institution. Brazil as a country is classified as having "graduate" status in AID terminology, based on national per-capita income. The Northeast, however, still faces staggering problems with the highest concentration of poverty found anywhere in the Western hemisphere. Agricultural and industrial development in Northeast have lagged far behind the rest of the country.

^{1/}The periods covered by this document are January 1, 1985, through Sept. 30, 1987 (FY85-87) and October 1, 1987, through Sept. 30, 1990 (FY88-90).

^{2/}See last page for definition of acronyms

Within the EMBRAPA system, certain of its national research centers could be considered as mature ("graduate" status) in terms of their infrastructure, critical mass of scientists, level of training of scientists, operating budget, and an effective producer clientele lobby. The CNPC, until this year the youngest of the EMBRAPA centers, has made remarkable progress since its formal inauguration in 1980, but could not be considered "mature" on the basis of any one of the above criteria. A more complete analysis of the factors leading to this conclusion follows below.

B. CNPC Infrastructure

By 1983 the CNPC had functioning basic laboratories for soils, nutrition, range, animal health, and reproductive physiology. Its land base (1,100 ha), however, was and still is not adequate for the research program.

In 1984 the following facilities were added:

- Metabolism laboratory for nutritional and feed evaluation
- Sound laboratory for audio-visual production
- Building completed for radio-immunoassay laboratories
- Development started on fencing and internal roads for 800-ha tract of land to be used by the CNPC under an agreement with DNOCS, including 20 ha to be irrigated for intensive forage production

Approval has also been granted for three additional projects which are scheduled for implementation during 1985:

- Development of 1000 ha for research at Saco Belem (east of Santa Quiteria) under an agreement with INCRA
- Construction and activation of a 300-doe dairy goat facility
- Dairy processing facility for goat milk and milk products
- A training facility with 30-bed dormitory, restaurant, and conference rooms

With the full implementation of these expansions to its physical plant, the CNPC, by 1987, will have attained an infrastructure that is quite adequate for a viable research program and outreach.

C. CNPC Scientist Staff

As with any young institution, the CNPC has had its ups and downs in terms of staff development. The general lack of trained scientists in Brazil made it necessary for EMBRAPA to hire people at the Bachelor's or Master's level and send them away for training to the M.S. and Ph.D. level. The state research agencies have had to do the same. Table 1 shows those scientists from the CNPC, EPACE and EMEPA (in disciplines collaborating with the SR-CRSP) who are away for training at the present time.

Due to the general lack of trained people in other institutions, not all scientists who return with a Ph.D. elect to stay at their original employing center. There has been and will likely continue to be attrition. Also, young scientists are often moved into administrative positions soon after they return from training. EMBRAPA has been faced also with the problem of a general hiring freeze (ceiling in number of total positions) which is still in force.

Table 1. CNPC Scientists away for Training (Dec. 1984)

<u>Scientist</u>	<u>University</u>	<u>Expected degree</u>	<u>Discipline</u>	<u>Expected return date</u>
Ederlon R.de Oliveira	Utah State	Ph.D.	Range Science	Fall 1986
Roberto Mesquita	Utah State	MS	Range Science	Summer 1985
Elino A. de Moraes	Texas A&M	Ph.D.	Range Science	Fall 1985
Aurino Simplicio	Utah State	Ph.D.	Reproductive Physiology	Fall 1985
Elsio Figueiredo	Texas A&M	Ph.D.	Animal Breeding	Fall 1986
Jose' Ubiraci Alves	U.F. Santa Maria	MS	Reproduction and Management	Fall 1985

EPACE* Scientists away for Training (Dec. 1984)

A. Amauri Oria' F.	Texas A&M	MS	Animal Breeding	Fall 1986
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EMEPa* Scientists away for Training (Dec. 1984)

Eneas L. Barbosa	Texas A&M	MS	Range Science	Fall 1986
Aldomario Rodrigues	Univ. F. Paraiba	MS	Animal Production	Spring 1985
Ana M. Wanderley	Univ. F. Paraiba	MS	Rural Economics	Spring 1985

*Note: For the State agencies, only those scientists in disciplines collaborating with the SP-CRSP are listed.

Because of these problems, the training function of the SR-CRSP is still very much needed, to help new appointees become established and to help recently returned trainees to mature.

A list of new appointees to the CNPC during 1984 is shown in Table 2. A few of these represent new positions; others are replacements for staff who have departed; and a few have been temporarily transferred from State agencies.

As of yet the CNPC has not achieved a critical mass in the number of scientists, and numerous members of its relatively young staff are still in the early stages of their professional development. Meanwhile, EMBRAPA counts heavily on the SR-CRSP and IICA to help provide senior and junior scientists to fill critical staffing gaps, and to fill a vital consulting and in-service training role.

D. Operating Budget and Clientele Lobby

Internal EMBRAPA documents show that proportionally to the rest of the country, total research resources available to the Northeast are relatively small. The incremental input to the CNPC, EPACE, and EMEPA budgets from the SR-CRSP are also small in absolute dollar amounts. However, it is quite clear that the SR-CRSP inputs play several critical roles:

- SR-CRSP funds can be mobilized rapidly to supply needed inputs on a critically timely basis.
- The SR-CRSP can facilitate equipment purchases from the U.S., sometimes at considerable savings over local prices, and at times facilitating the purchase of items unavailable in Brazil.

Table 2. New Scientists at the CNPC, Appointed during 1984

<u>Scientist</u>	<u>Discipline</u>	<u>Highest degree</u>
Joao Ambrosio Araujo	Range Science	Ph.D. (U. Arizona)
Heloisa Carneiro	Nutrition	M.S. (U.F. Pelotas - RGS)
Jose' de Sousa	Economics	M.S. (U.F. Ceara')
J. Wellington dos Santos	Statistics	M.S. (U.S.P. - S. Paulo)
Paulo F. Almeida	Microbiology	M.S. (U.N.A.R.P. - S. Paulo)
Sebastiao Freitas	Outreach	B.S.
J. Barroso Filho ^a	Animal breeding and management	B.S. (C.C.A. - UF - Pb)
Bernadone Pinto ^b	Outreach	B.S.
Angela Xavier Eloy ^c	Reproductive physiology	M.S. (U.F.R.P. - PE)
Elisabeth Berne	Pathology	M.S. (U.F.R.G.S. - RGS)
?	Animal Breeding ^d	Ph.D.
?	Rural Sociology ^d	Ph.D.
?	Veterinary Medicine ^e	D.V.M.

^aEPACE Scientist assigned to CNPC

^bEMATER-CE Specialist assigned to CNPC

^cAppointment effective Jan 1985

^dpositions presently being advertized

^eNon-research, service position, pending final approval in Brasilia

- Support can be given to newly hired scientists or newly returned trainees during the immediate fiscal year, without having to wait the 6-18 months necessary for new project approval and funding within the EMBRAPA system.
- Support can be given to recently graduated BS-level Brazilian nationals to acquire experience in their particular discipline, and CNPC/EMBRAPA can hire from this group of people with greater assurance of obtaining qualified individuals.
- Better utilization of existing infrastructure is possible when certain CNPC resources become limited or unavailable.

Experience in more-developed countries has shown that a research institution is unlikely to be adequately funded unless it has a strong clientele lobby. Due to the complexities of the agricultural production systems and the socio-economic reality of the Northeast, there is only an embryonic awareness of the potential contribution that the CNPC can make for small ruminant producers in the Northeast. Part of the problem is that the CNPC itself is still struggling to identify its precise role within the reality of the Northeast, where production units typically mix cattle with sheep and/or goats, along with several food, fiber, or forage crops, within a context of complicated land tenure and labor utilization patterns.

In spite of a weak linkage with EMBRATER and the immature status of CNPC research and outreach programs, evidence is available that a producer clientele is developing. Letters from producers and students are received on a regular basis, soliciting advice and publications. Extensionists from the EMBRATER system and livestock specialists with

various financing institutions are beginning to seek the CNPC's advice on development related issues. Certainly, one of the challenges for the SR-CRSP during its remaining years of tenure in Brazil will be to help the CNPC capitalize on these and other opportunities to build confidence within its natural clientele, and to be responsive to their needs.

E. Progress in Collaborative Research, 1980 - 1984.

The results of SR-CRSP research projects to date have been documented in CNPC publications, Reports, Lists of Research Publications, and "Partners in Research" (the SR-CRSP 5-year report).

The Brazil site has been productive in terms of research publications. A conservative estimate is that about 25% of the total overseas-generated abstracts, refereed journal articles, and student theses reported by the SR-CRSP institutions through 1984 came from the Brazil work. This includes 32 published abstracts, 24 journal articles published or submitted and 7 PhD and MS theses. This record speaks for itself in terms of the research output of a collaborative projects to date, despite the infancy of the CNPC as a research center.

In Summary, the CNPC has made remarkable progress in a short time. Admittedly, it still needs help from outside in terms of institution-building. At the same time, it has proven willing and able to contribute strongly to successful collaborative research projects. The future bodes well for continued measurable results from the institution-building, training, and collaborative research missions of the SR-CRSP.

2. Program Plans, FY 85-87

There is no major change foreseen for the conduct of the six sub-projects of the SR-CRSP in Brazil for the coming 3-year period. Individual summary workplans are presented in this section, along with a description of integrated program activities which are directed by the BZ-PAC and supported with Brazil country program funds and allocations from individual projects.

A. Integrated Research Projects

The Brazil PI's are fully committed to increasing levels of support for well-integrated collaborative projects. If properly conducted, such projects can achieve several desirable results:

- The information obtained will be more complete and more applicable to real production situations.
- Information exchange among discipline groups is facilitated.
- Cross-discipline planning and interpretation will lead to more innovative research.
- There will be an economy in use of land, animals, personnel and experimental equipment.

Toward these ends an integrated study was initiated in late 1984 on energy supplementation of pre-pubertal Moxoto does (goats) grazing caatinga rangeland. This project involves collaboration among EMBRAPA and the following CRSP projects: Utah Reproduction, Texas Breeding/Management, California Health, North Carolina Nutrition and Utah Range.

Dr. Jorge Kawas, site coordinator, is the project leader. This project will continue into 1986.

In 1986, a new and larger collaborative project is planned for implementation. This will be conducted in the Saco Belem area east of the town of Santa Quitéria. Roughly 600 ha of native caatinga land have been placed under authority of EMBRAPA for development of technology and practices suitable for application on small farms created by re-settlement of poor people from urban centers. All CRSP projects expect to collaborate with CNPC in this venture. It should provide an opportunity for application, on a production scale, of the most promising technology that has grown out of CRSP and EMBRAPA research to-date.

B. Training

Two major developments are expected to impact the training activities of the SR-CRSP.

First is the decision to make resources available for Brazilian graduate students to conduct research at the CNPC. A proposal to accomplish this, with joint funding from EMBRAPA and the SR-CRSP has been developed and is in the discussion stage. Highlights of this proposal (as of mid-Dec. '84) include: (a) MS thesis research by students from Brazilian universities; approximate cost, \$3,500 for a 12-month period including 10 months for data collection and 2 months for writing. This is an average tenure. (b) Ph.D. research, financed half by the SR-CRSP and half by EMBRAPA. This would entail rigorous screening of candidates (MS people from Brazilian universities) with

the goal of going to the US for coursework. Estimated costs would be about \$5,000 per student for CRSP-contributed funds and an equivalent amount from EMBRAPA. Questions on admission to US universities and financing are still being explored.

Second is the expected construction of a training center at the CNPC. This facility will house conferences, seminars, and workshops, involving extension agencies, local universities, state and regional research institutions, other local development agencies, and possibly some workshops at the international level. These activities will greatly facilitate outreach and the exchange of information, including feedback from potential users of research results.

C. State-of-the-Art Workshop

A proposal is being developed to hold a major workshop in Sobral in early 1986. The purpose would be to review CNPC/SR-CRSP research to date, along with related literature, and prepare a major publication of these, synthesizing review papers for each discipline area. This document could serve for AID, EEP, and EMBRAPA evaluation of the SR-CRSP program; a summary record of information generated to date; and the basis for preparing a series of extension leaflets.

D. International Goat Conference

In March 1987, the IV International Goat Conference will be held in Brasilia. This will present a unique opportunity for SR-CRSP/CNPC collaborative research to be presented to a world-wide audience, and for EMBRAPA scientists to receive and exchange information with scientists from other major goat research centers world wide.

E. Individual Project Workplans, FY 85-87

(1) Utah State University, Range Project

The major goal of the range project is better definition of the forage-to-animal supply-demand relationship, and how this relationship can be improved by various low technology manipulations of the native caatinga vegetation. This is being approached through testing of forage responses on native and manipulated caatinga, as well as animal response in terms of diet quality, forage intake, and animal feeding behavior. PhD-level graduate training for both Brazilian and US nationals will continue to be emphasized. The range project will play a major role in the anticipated integrated project at Saco Belem.

Specific project components on-line or planned include the following (co-investigator or graduate student indicated in parentheses):

- Ecological assessment and plant-soil-climate relationships (Joao Queiroz).
- Range improvement and methods of caatinga cutting (Linda Hardesty).
- Caatinga clearing and forage and animal response (Walter Schacht).
- Effects of fertilization of caatinga species on acceptability and nutritional value to browsing animals (Amanual Gobena).
- Comparative feeding ecology and nutrition of sheep and goats in caatinga vegetation (Scott Kronberg).
- Evaluation of improved forage species with sheep and goats (Roberto Mesquits).
- Determination of comparative energy expenditures of free-grazing sheep and goats, as influenced by amounts and kinds of available forage (Ederlon Oliveira).
- Effects of soil nutrient status on the production of anti-herbivore secondary compounds by caatinga trees and shrubs (Fred Provenza (USU) and John Bryant (Univ. Alaska)).

(2) North Carolina State University Nutrition and Forage Project

The general emphasis on the nutrition and forage project as it has evolved for the 1984-85 program year will continue until 1987. Research will focus on the following questions:

- Management and supplementation of SRD does to optimize year-round productivity of the doe and kid flock.
- Identification of mineral-related problems and supplementation needs
- Nutritive evaluation of feed resources for dry season supplementation, including native or cultivated forages and byproducts.
- Integrated research projects involving the collaboration of several disciplines, to focus on interactions among various components of the production system.

The project will attempt to focus on feeding problems from two equally important angles:

- The economic and practical capabilities of producers to adopt feeding interventions.
- The need to understand biological system, including the nutritional requirements of local sheep and goat breeds; their response to supplementation, especially energy; and the interaction of animals with the basic feed resource (caatinga vegetation).

There will be a special effort to accelerate the rate of publication of completed research, including extension-oriented bulletins and circulars in Portuguese and technical reports in both English and Portuguese.

Complementary research will be carried out at the Raleigh campus, aimed at understanding the nutritional responses of goats and tropical sheep to varying kinds of fiber in the diet, and to varying degrees of underfeeding (simulating the dry season) and recovery (simulating the early wet season conditions).

Personnel currently available to the project include Nelson Barros and Heloisa Carneiro of the CNPC staff; Helaine Burstein, Ph.D. candidate (through early 1986); Dr. Jorge Kawas (20% time from October 1985); with backstopping from Drs. W.L. Johnson (PI), J.E. van Eys, and J.W. Spears, from Raleigh.

All assistance possible will be extended to the CNPC staff for their Ph.D. study programs. Also the involvement of M.S. students from Brazilian universities will be encouraged, in support of thesis research conducted at the CNPC. The proposed new program to train Brazilian M.S. graduates to the Ph.D. level will also be supported to the maximum that funds allow.

(3). Texas A&M Univ. Breeding and Management Project

In the period 1985-87, the Texas A&M University project in Brazil is expected to go through a phased change-over to where work will be conducted primarily through support and collaboration with returning Brazilian scientists who have received advanced training as a result of SR-CRSP involvement. In addition, it is expected that support of graduate students attending Brazilian Universities to conduct research with sheep or goats in collaboration with CNPC and SR-CRSP will become a significant part of the effort. As shown earlier, four students are involved in training at Texas A&M University. Four additional students are in the process of making applications to attend TAMU, some of which are expected to arrive by September 1985. Also, four students now studying in Brazil are associated with TAMU efforts. These students require continued support for generation of research data for thesis projects in Brazil or in Texas and for staff time involved with their program.

The nature of the proposed work in Animal Breeding will consist of supporting two breeding projects at EPACE (Quixada). These projects are designed to (a) provide data for thesis projects of appropriate graduate students, (b) provide a basic body of data for analysis to determine future directions, and (c) initiate and carry out appropriate selection programs. The sheep project relates to selection of Morada Nova sheep, whereas the goat project relates to identifying the appropriate crossbred populations for direct exploitation or to provide a crossbred foundation for future selection. Data collected on both populations are being used to partition losses in total productive efficiency to indicated future areas of research. One specific question being addressed is the desirability of encouraging multiple births under adverse conditions. Other questions of basic nature are being or will be addressed.

Collaborative breeding work at CNPC Sobral or that which is supervised from Sobral includes support and collaboration with a project involving 10 producer flocks. This project will provide basic performance data under farm conditions, will provide a test comparison of existing vs. improved systems at the producer level and provides nucleus breeding flocks to develop and distribute superior breeding stock.

The TAU project has assisted and is assisting in the development of the DNOCS area for the conduct of Animal Breeding efforts at Sobral. Current plans call for long term improvement programs with Santa Inez and Somali sheep. These will continue in the future. Breeding work with goats at Sobral are directed at the development and release of improved types for meat production in the Northeast. This will involve crosses of native types with appropriate introduced types. The currently available introduced breed is the Anglo Nubian. Efforts are being made in Brazil to introduce and evaluate the Boer goat. The opportunity to make observations on the Boer goat should

hold great interest in the SR-CRSP. These improved meat types are expected to be released to the public along with technology packages designed to increase overall productivity.

Breeding work in Paraiba is concerned with evaluating local and exotic dairy types in the region. TAMU efforts are concerned primarily with a study of the interaction of these genotypes with production and management systems for milk production. In addition, the BNB is initiating production projects throughout the Northeast involving meat and milk production, which are being initiated with the intent of receiving participation from TAMU.

Management Studies: The major effort relating to this component is the management systems relating to milk or dairy production in Paraiba. These include an economic feasibility study which will be completed in the near future. The degree to which dairy production from goats will become a major factor in the Northeast is not clear at present. However, it is evident that this is the area where research is likely to make the greatest impact at the producer level. Field studies are already underway involving producers, and workers have been requested to provide assistance to a number of producers in initiating programs involving milk production. Research work underway which will be carried to completion includes systems of management (partial vs. total weaning of kids and feeding vs. no feeding of does on caatinga) of the milking doe, methods of kid rearing, ration formulation, and production of forage for use in supplemental feeding. Some of the above studies have been and will be conducted in collaboration with other projects, such as NC State and University of California (Health). It is anticipated that this series of studies will be carried to completion in the next year, and that the data should be adequate to develop a proposed technology package for dairy production at the farm level. The development and elucidation of this package will be a high priority goal in the 1985/86 period. Following this, it is anticipated that much of this effort in Paraiba will be carried on by EMEPA workers and the TAMU role at this site will be reduced. Further work with dairy production is anticipated to be multi-disciplinary effort located at Sobral. The preparation of a series of research papers for publication or for presentation at the 1987 International Goat Conference will require a significant amount of time in the next 1.5 years. The SR-CRSP involvement with the IV Goat Conference should be of value both to the conference and to the CRSP, and programs in Brazil should be geared to this end.

Other management studies have and will continue to serve a broader role for sheep and goat production. One of these is fencing which has been identified as a major limitation. The comparative cost and effectiveness of various types of fencing have been and will continue to be studied. Some of this is involved with new construction in the development of new areas as the DNOCS site.

The effort at partitioning of production losses (reproduction, growth and survival) is expected to provide clues for meaningful further research to be conducted in the near future. These are expected to be related to choice of breeding season and forage production to bridge critical periods. There is also a great need to determine if protein (including NPN) or mineral supplements will enhance production of animals utilizing caatinga. Studies of this nature will be conducted at Quixada and in Paraiba.

In addition to the above, the TAMU project is, and will continue to be, associated with multidisciplinary projects conducted at Sobral. The current project involves the work of Dr. J. Kawas, and new effort of a multidisciplinary nature are expected in the future.

A number of investigations are in process in Texas which relate to the overall SR-CRSP goals. These are expected to be continued. A large number of Brazilian scientists are associated with these efforts at Sobral, Quixada and in Paraiba. The U. S. and expatriate scientists involved, in addition to the PI, are Dr. Carlos Zometa, Dr. J. Kawas in Brazil, and Dr. J. O. Sanders and Dr. J. E. Huston in Texas. The latter two are and will continue to be primarily involved in working with graduate students.

(4). Utah State University Reproduction Project

This project has several goals. These are to:

- Continue evaluation of the reproduction and production capabilities of various genotypes of goats and hair sheep, with emphasis on environmental effects.
- Continue and extend the application and testing of low technology management practices to improve production of CNPC and producer flocks, including increased efforts through interdisciplinary collaborative programs.
- Continue and expand institutional building efforts (1) by developing and establishing a functional radioimmunoassay (RIA) program in the radioisotope laboratory, and by assisting with other facilities and equipment needs, (2) through continued graduate training (M.S. and Ph.D. degrees) in Brazil and the United States, and short term, non-degree training at CNPC.
- Assist in expanding CNPC and SR CRSP reproduction expertise through the development of a reproduction network program among EMBRAPA research units in northeast Brazil.
- Continue primary support to personnel working in reproduction at the CNPC including research program development and conduction, and publication of results in Portuguese and English, as appropriate.

- (5). Univ. of California (Davis) Health Project.
(Editor's note: No summary available at time of this writing)

(6). Winrock Economics Project.

The Workplan for the next three years builds upon the major findings of the first five years of fieldwork which focused primarily upon production systems found in Ceara State. First, marketing of SR's was not a major constraint; although prices of SR meat are lower than for beef, there isn't much we can do about it. Second, mixed farming systems (crops plus 2-3 species of livestock) predominate but we are not sure of this pattern for other important SR areas in the Northeast. Third, producer herd/flock structure and intensity of management applied is a function of the micro ecology of the farms and it will probably be difficult to develop technologies to fit a broad range of conditions. Finally, on-farm testing of new practices will be difficult but not impossible if simple approaches are used.

The next phase of the economics project will thus focus on four major areas of work:

- We will extend our previous survey methodologies to other areas of Northeast Brazil, to focus on micro ecological conditions (soils, vegetation) as well as socioeconomic characteristics of producers. Survey data will be used to characterize main production systems and to use these characterization studies to help develop and test new technology.
- A limited amount of economics research will be started on dairy goat production systems and the economics of product processing, distribution and marketing. This will support CNPC's new research thrust to establish viable dairy goat units in the Northeast.
- Work on farm management models will continue and more emphasis will be placed on the ex-ante evaluation of center research results at the producer level.
- Finally, the economist will work closely within multidisciplinary teams to design and conduct on-farm experimentation with cooperating producers and on-plot farms.

To carry out this Workplan will require the placing of a Ph.D. level economist in Brazil on a full-time basis by mid-1985 with additional technical and advisory inputs by Dr. Nestor Gutierrez (SR-CRSP, Peru) over the next year.

We hope to bring our Brazilian counterpart to the U.S.A. for some informal training in 1985 and to start him on a Ph.D. program in 1986.

(7) University of Missouri Sociology Project

Although the Missouri Sociology project has not budgeted on-site research for Brazil during 1985-86, there is continuing commitment for collaboration over the long term. This would probably take the form of short-term site visits (weeks) to provide technical guidance and orientation to the new CNPC sociologist, once this position is staffed. Assisting this person in building ties to past work done by Missouri researchers would be an important endeavor. Also emphasized would be provision of a good background in contemporary issues of agro-pastoral research, especially as they pertain to small ruminant production systems.

3. Program Plans, FY 88-90

By the end of 1987 we expect sufficient progress to have been made to allow a shift of emphasis in the interaction between the CNPC and the SR-CRSP. This shift will likely be gradual and evolutionary, rather than an abrupt change. The kind of inputs expected to be necessary for research, training and institution building are described below.

A. Research Goals

By 1987 there should be enough solid information of practical applicability to be able to move confidently to on-farm pilot testing, in full collaboration with the EMBRATER agencies and other regional or State development organizations. Ideally, a strong three-way dialog will be engendered among research, extension, and farmer leaders. Such an activity will be a logical adjunct and outgrowth of central integrated projects at the CNPC.*

*At the time of this writing (Dec. 1984) a World Bank funded project to link EMBRAPA centers in the Northeast more closely with extension programs is under discussion.

Scientists returning from M.S. and Ph.D. studies abroad will be able to assume more and more leadership responsibility for the national research program, with the SR-CRSP reverting to more of a consultative role. At the same time we expect that research projects designed to further understand the biological system (animal, caatinga, and animal/feed resource interaction) will still be necessary, particularly to ensure extrapolability of results from Northeast Brazil to other parts of the world which have similar types of animal and range resources.

B. Training

Only a small part of the total CNPC scientist body will have achieved the Ph.D. level of training by 1987. This aspect of the program must continue through 1990, and will need the support EMBRAPA and other Brazilian scientists for high quality thesis research, oriented toward practical applications in Northeast Brazil.

At the same time there should be increasing opportunities for scientists-in-training from third countries to conduct thesis research at the CNPC. USAID trainees from other countries with semi-arid ecosystems could benefit from involvement with the Brazil program. In order of decreasing ease of adaptability, these students could come from countries where Portuguese, Spanish, French, English, or other languages are used.

Training will also continue in the following forms:

- In-service training of new staff and persons returned with graduate degrees

- Graduate students from Brazilian universities
- Post-doctoral programs and other special activities for senior-n level Brazilian scientists

C. Institution Building

The building of a strong user clientele for the CNPC will be a major goal of the 1987-90 period. This will be accomplished through the following activities:

- Integrated, collaborative research involving all disciplines
- On-farm testing of applicable new technology
- Shortcourses, seminars, workshops and publications

D. Individual Research Projects

Specific activities within the various disciplines cannot be predicted this far in advance. However, it is expected that all sub-projects will follow and build upon the objectives and activities of the 1985-87 period. We anticipate that all projects will conform to the following general considerations:

- Increasing transfer of leadership responsibility to Brazilian collaborators. The collaborative projects can serve as a vehicle to foster maturation of newly-trained scientists.
- Strong involvement in integrated, multi-disciplinary activities.
- Testing improved practices at the farm level, in collaboration with extensionists from the state affiliates of EMBRATER.
- Fostering communications and collaboration with universities of the Federal system and the various state research agencies.

- Reaching out to third countries, through the mechanisms of conferences, shortcourses, scientist exchange, and third country student thesis research conducted at the CNPC.

4. Other Considerations in Support of Continual SR-CRSP Activity in Brazil Through 1990.

In addition to the justifications for a continued research, training, and institution building role with the CNPC, outlined in previous sections, there are other factors which were discussed in relation to a continued SR-CRSP presence into the FY 88-90 period. These are listed below.

- A. Brazil is the only present SR-CRSP site where tropical hair sheep are part of the production system, and where there is access to research flocks of these important breed types.
- B. The proposed new research program on dairy goat production systems for Northeast Brazil will offer some prospect for generating food and employment on small farms. The U.S. collaborating institutions have expertise in this area which will be valuable to EMBRAPA in evaluating the potential of dairy animals in Northeast Brazil.
- C. EMBRAPA offers good opportunities for women professionals, both Brazilian and SR-CRSP participants.
- D. Students continue to be welcome at the CNPC, from U.S. and Brazilian universities.

- E. EMBRAPA has provided good support for facilities development, equipment, and animals. This has allowed the limited SR-CRSP funds to be used for critical support of researchers, travel, training, short courses and a few strategic items of equipment not available in Brazil.
- F. Research and living costs in Brazil have been very reasonable, and research output high; a very favorable benefit-cost ratio is the result.

Definition of Acronyms

AID	Agency for International Development
BNB	Banco do Nordeste do Brasil
BZ-PAC	Brazil Project Administration Committee
CNPC	Centro Nacional de Pesquisa de Caprinos
DNOCS	Departamento Nacional de Obras Contra as Secas
EMBRATER	Empresa Brasilia de Assistênc'ia Técnica e Extensão Rural
EMATER-CE	Empresa de Assistênc'ia Técnica e Extensão Rural do Ceara'
EMEPA	Empresa Estadual de Pesquisa Agrapecuaria do Paraiba
EPACE	Empresa Estadual de Pesquisa Agropecuaria do Ceara'
EEP	External Evaluation Panel
FY	Fiscal Year
INCRA	Instituto Nacional de Colonização e reforma Agraria
IICA	Instituto Interamericano de Cooperac'ão Para Agricultura
PI's	Principal investigators (of SR-CRSP)
SR-CRSP	Small Ruminants Collaborative Research Support Program
TAMU	Texas A&M University

Work plan summarized for Malachuk's report: (FY 85-87)

One of the major original priorities of the Animal Health position of the Brazil CRSP project was developing methods for control of caseous lymphadenitis, a chronic insidious disease of high prevalence in the Northeast which causes considerable economic loss.

Through CRSP research efforts over the last 3 years, great headway has been gained in terms of understanding the pathogenesis of the disease and in the development of a much needed serologic assay for detection of carrier animals.

The next step in this research is the development of a vaccine for protection against the disease. An experimental vaccine trial, using a toxoid of the organism is already underway at UCD and extensive field trials are planned for further testing of efficacy in 1986-1987 in Northeast Brazil.

The health project will continue its study of endemic diseases of small ruminants, especially in light of how management factors affect the prevalence and severity of these diseases.

Pneumonia continues as an ever-present cause of high mortality among the young. Etiologic agents and their antimicrobial patterns are being examined. Effects of environmental manipulations are being assessed to determine how management factors could help to decrease incidence.

Mastitis projects already underway will be expanded. Preliminary studies have focussed on etiologic factors. Future plans are to maximize dairy output by minimizing the extent of both clinical and subclinical mastitis.

Nematode parasites remain a very significant cause of both morbidity and mortality among goats in the Northeast. Work to date at the CNPC has demonstrated effects of various anthelmintics on worm burdens. The current plan is to study how various types of management factors (specifically, housing) affect the rate of infestation.

Mycoplasmosis of kids a newly-recognized caprine problem in Brazil, will be examined at the CNPC, including the incidence, prevalence, and environmental factors predisposing to this disease.

CRSP will establish a clinical epidemiologist at the CNPC in 1985-86. This person will function as much needed clinical veterinarian and herd health advisor for the center, and will also participate in clinical experimental trials, such as the caseous lymphadenitis vaccine project.

Isolation pens for work with infectious diseases which were planned by 1984-85 were postponed because of the construction needs for the multidisciplinary project. Construction is now planned for 1986. Such pens will greatly facilitate experimental manipulations needed to understand mechanisms of disease and their control.

SR-CRSP INDONESIA

1987 - 1990

1. PRESENT STATUS

Presently, the SR-CRSP is involved in two village programs and two station programs. The first village program started in 1980 and was the basis for nutrition, breeding, and socioeconomic monitoring and baseline data collection. In 1984, the number and frequency of the visits was brought down depending on the number and kind of on-farm trials being conducted. Production parameters at different altitudes (highland and lowland) continue to be monitored.

In late 1984, as the research program moved from the descriptive phase to the experimental and technology testing phase, the focus of the program in West Java shifted to the Outreach Pilot Project (OPP) which involves at least 12 villages around Bogor. Each village has a unit-farm which serves as field laboratory, demonstration farm as well as a (small) multiplication center.

At the same time a new program has started in North Sumatra at the brand new substation in Sei Putih. Earlier research had indicated the high potential for small ruminant-plantation association, which is now studied in further depth in close collaboration with the neighboring rubber research institute. The Sei Putih substation will achieve the status of "institute" in 1986 (i.e., with own budget). It is presently a very young station with inexperienced staff and in need of technical and financial support.

2. ACCOMPLISHMENTS

2.1 Institutional

- The SR-CRSP has been instrumental to the establishment of a strong small ruminants program at the Research Institute for Animal Production (RIAP), by far the strongest commodity oriented program.
- The SR-CRSP has played an important and probably essential role in the establishment of a farming system program at RIAP.
- The SR-CRSP has contributed to the successful merger of the original Research Station for Animal Husbandry (LPP) and the Australian sponsored research station for animal production and development (RPPP) into RIAP (BPT).
- The SR-CRSP has established a collaboration program between RIAP and the Research Institute for Animal Disease (RIAD) thereby steering the veterinarian research to small ruminants.
- The SR-CRSP has supported a strong training program of RIAP scientists who have all remained within the SR-CRSP program.
- The SR-CRSP has established a strong publication record with nearly 50 working papers published and numerous articles and abstracts.
- The SR-CRSP has established strong data processing units, at RIAP-Bogor as well as at the Sei Putih substation.
- The SR-CRSP provides essential support to the development of the Sei Putih station, where other technical assistance is lacking.

2.2 Technical

The SR-CRSP activities are categorized in three programs, i.e., breeding, nutrition, and socioeconomic. The latter category includes sociology and economics.

Research of the past 5 years has generated a substantial amount of basic information. The surveys and the long-term monitoring of small ruminant production systems in West Java have identified a number of critical nutritional and managerial limitations to increasing productivity. Concurrent station research on specific feedstuffs has provided insight and possibilities for maximum utilization of large roughage base, and suggested optimum combinations of readily available by-products of agriculture and industry. Specific nutritional deficiencies in the small ruminant diet have been identified and solutions are being tested.

At the Cicadon station, very good data on inheritance of prolificacy have been (and are still being) collected. Village performance data on sheep and goat has indicated the parturition interval as a main constraint. Plans are being finalized to ship hair sheep breeding stock to the RIAP(BPT) substation at Sei Putih, North Sumatra.

By 1987, it will be known if the exceptional variability in prolificacy of Javanese sheep is due to segregation of a gene with a large effect on ovulation rate. If the preliminary conclusion that this is the case is confirmed, the program will be well into the process of establishing several lines with high and low prolificacy and have started tests of the two kinds of rams in our village programs.

The socioeconomic work, which has been partly conducted in collaboration with the Satya Wacana University in Salatiga, has focused on the types of management (traditional versus semicommercial; herding versus complete confinement), resource allocation (labor, cash), types of labor (husbands, women, children), sociological environment, and market structure. As the biological programs enter the technology design/evaluation phase, the participation of the socioeconomic group in on-farm testing becomes more critical.

3. STAFFING

Among the Indonesian PIs, an agreement was reached to maintain at least two expert positions in Indonesia, one being a biological scientist, and the other a social scientist. Presently, Drs. Jensen and Gaylord advise the RIAP researchers at RIAP, while Mrs. Alice Reese (nutrition) provides support to the research activities in Sei Putih. The SR-CRSP benefits from close collaboration with temporary assigned RMI experts, Drs. Peters, Gatenby, and Levine. This support will be reduced to two part-time persons in September 1985 and will end in September 1986.

4. TRAINING

4.1 Breeding

Mr. Subandryo (M.Sc., Montana) has assumed leadership in the small ruminant research program. He expects to return to the United States in 1986 or 1987 for his Ph.D. study.

Bess Tiesnamurti and Ismeth Inounu recently started their M.S. studies at University of California, Davis, and Oregon State, respectively. Bess will finish before September 1987. Bambang Setiadi is pursuing a M.S. degree at IPB (Bogor) while Mrs. Endang Triwulanningsih likely will continue for her Ph.D. degree at IPB.

4.2 Nutrition

The following members of the nutrition group are pursuing a degree, with expected date of completion and area of interest:

H. Pulungan	Ph.D.	Indonesia	1988	energy utilization
M. Sitorus	Ph.D.	Indonesia	1987	energy utilization
B. Haryanto	Ph.D.	U.S.A.	1987	forage utilization
A. Djanjanegara	Ph.D.	Australia	1986	crop by-products
M. Winogrohu	Ph.D.	Indonesia	1987	crop by-products
T. Panggabean	Ph.D.	Australia	1986	mineral nutrition
A. Prabowo	M.Sc.	U.S.A.	1985	mineral nutrition
W. Mathius	M.Sc.	U.S.A.	1987	crop by-products

Currently not following graduate studies at BPT:

M. Rangkuti	M.Sc.	protein supplementation
S. Silitonga S.	M.Sc.	by-products
P. Mahyudin	M.Sc.	fiber utilization
Kusnandi	M.Sc.	forage utilization
S. Ginting	B.S.	protein nutrition
P. Pongsapan	B.S.	crop by-products

This list clearly demonstrates the reason for the lower research activities at the present time and the potential acceleration of research following 1986 to 1987. The research areas in which the graduate students are working is in agreement with the research priorities outlined above.

4.3 Socioeconomics

Mr. Sabrani will finish his Ph.D. degree in 1986. Kedi Suradisastra and Tjeppe Soedjana started their Ph.D. studies at Missouri and Oklahoma State, respectively. Agus Mulyadi (M.Sc., Texas A&M) will start his Ph.D. study after Sabrani has completed his. Sri Wahyuni is a

potential M.Sc. student at Missouri. By 1987, Kedi and Tjeppy are expected to be in Indonesia to conduct thesis research.

4.4 Short-term Training

Two training courses in English have been conducted. Short-term training (3 months) has been provided to two members of communication staff at Winrock International (Elyda D. and Kosasi) and to A. R. Siregar at Texas A&M for systems modeling.

The SR-CRSP benefits from the fact that all Indonesian staff after their training return to their previous positions and thus contribute to the strengthening of the program.

5. FUTURE COURSE

5.1 Bogor (West Java)

By 1982, it is expected to have well-trained research staff involved in small ruminant research at the Bogor BPT station. Although regular assistance by senior scientists will be warranted, it appears that short-term visits would be enough to keep the West Java program operating at a productive level. The involvement of the U.S. institutions will thus change from a direct and active participation to the role of backstopping, advising, and catalyzing. This function must be considered essential given the well-documented problems which recent graduates of foreign universities face upon return. This step in the SR-CRSP program is expected to last 3 years during which Indonesian scientists will develop their own research program and solidify the support base for their projects (including outside grant support). In the area of training and education, responsibilities and assistance of the SR-CRSP program will mainly be limited to short-term training in specific research methods and techniques, and providing for scientific exchange.

The breeding subprogram, given the long-term nature of the genetic research, might require somewhat more supervision. The high prolificacy stock will require improved feeding and management for their effective exploitation, and development of production packages in collaboration with the nutrition subprogram will require increasing emphasis. Implementation of the planned field evaluation program will be carried out in collaboration with the sociology subprogram, and critical evaluation of results will require participation from CRSP economists. The production packages will also include information on selection and management practices, to increase frequency of parturitions, and to increase growth rates. Thus, at the Bogor station, the breeding subprogram will provide leadership in directing the research activities.

5.2 Sei Putih (North Sumatra)

The station in Sei Putih is extremely young and will require technical assistance for a number of years, at least through 1990. The mandate of the institute at Sei Putih is the animal production research in plantation-ruminants farming systems. Among the most promising associations belong rubber - small ruminants, oil palm - small/large ruminants, and coconut - small/large ruminants. Presently, the emphasis is on rubber - sheep production systems.

As research at Bogor will reach the phase of technology extension, and increasingly will be conducted by the BPT staff themselves, the emphasis of the CRSP will shift to the Sei Putih station. The location of the Sei Putih station and its mandate gives the SR research worldwide relevance. The plantation production systems in North Sumatra are similar to those in other parts of Asia (Malaysia), Africa (West Africa in particular), and the humid areas of Latin America (e.g., Brazil).

The SR-CRSP will aim to maintain its commitment to provide two resident scientists to Indonesia, but their host station will shift from Bogor to Sei Putih. Short visits to the BPT Bogor will still allow to maintain the CRSP collaboration in West Java.

Nutrition research will continue to explore the most optimal management systems under rubber by screening pastures and evaluating feed management systems (cut-and-carry, herding, fencing, etc.).

Breeding research will focus on the development of a hair sheep strain by crossing St. Croix sheep with local ewes. The evaluation of the hair sheep and their F₁ progeny from local ewes should be well started by 1987.

So far the genetic research on goats has been limited. By 1987, it is expected to develop a more active research effort on goats as they contribute two-thirds of the Indonesian small ruminant population. It will probably be oriented towards genetic improvement of milk production potential. A comprehensive program should be ready by 1987.

The sociology and economic program will be essential in integrating the small ruminant research at the animal production research institute at Sei Putih and the neighboring rubber institute. Scientists at both institutions will collaborate better when sociological and economic data illustrate the benefit of integrated production systems and, therefore, integrated research. Sociological research will focus on hired labor -- plantation owner interaction while economics will collaborate with the nutrition subprogram by evaluating promising management packages.

6. JUSTIFICATION

Justification for extension of the SR-CRSP in Indonesia is found in four major areas, i.e. the relevance of scientific research, the institutional development (a.o. the training), the integration of research activities.

6.1. Relevance of Scientific Research

Indonesia is the only humid tropics site within the SR-CRSP. Research results have relevance for other parts in the humid tropics as well, especially since the recent expansion of the program to the Sei Putih station in north Sumatra. Major research goals include:

- Development of high and low prolific strains of Indonesia sheep.
- Introduction of hair sheep genetic material to Asia and evaluation of crosses.
- Evaluation of goats of improved potential for milk production.
- Development of supplementation feeding "packages" for cut-and-carry production systems.
- Formulation and testing of promising mixed small-ruminant tree-crop plantation systems.

These important aspects of work will be at mid-stage development in 1987. Past results have shown that the research goals are within reach if given enough time. Past experience has also shown that the presence of a strong sociological/economics component is essential for the successful testing and applicability of "technical" packages.

6.2. Institutional Development

Equally important to the completion of small-ruminant scientific research efforts is the provision of support during the 1987-1990 period for the young Indonesian scientific staff returning with advanced degrees. Continued financial and consultative support during this critical period will be extremely important in helping them become established in a productive research program with small ruminants. The potential for such a program, based on interest of these participants and support from BPT Administration, is judged to be very good; termination of SR-CRSP support in 1987 would greatly reduce the probability of realization of this potential. For example, there were no BPT staff members trained in the field for animal breeding working with

small ruminants in 1980, when the CRSP was initiated, and the first person with an M.S. degree from the United States returned only in 1984. Considerable progress in training and in establishment of research capability will have been made by 1987, but that is much too early a date to terminate the program if the goal is to develop a program in this area to the stage where there is a high probability of its continuing after external support ends.

Continuation of external support is in particular important for the new and substation at Sei Putih, which will start operating under its own budget just before 1987. The SR-CRSP should fulfill its commitment to the successful finalization of the development of this station.

6.3 Integration of Research Activities

The SR-CRSP has played a pioneering role in demonstrating the need to integrate research activities. Despite the small resource base of the program in Indonesia, a comprehensive research program could be maintained by the strong collaboration not only between the SR-CRSP subprograms, but also between the SR-CRSP and other research programs (notably the Farming Systems Program) as well as between the SR-CRSP and other institutes (notably the Research Institute for Animal Diseases and a number of Indonesian Universities). The SR-CRSP therefore fulfills an essential function in catalyzing collaborative research. Termination of the program no doubt would endanger a number of integrated programs, possibly all of them.

SR-CRSP/KENYA PROGRAM PLAN

1985-1987, 1988-1990

PROBLEM STATEMENT

Activities of the SR-CRSP in Kenya are focused on developing and evaluating dual-purpose goat production systems that fit needs of farm families with sharply limited resources of land and capital. These needs include a high quality protein supplement to family diet and a "cash crop" to generate income and build equity to move family beyond a marginal subsistence way of life.

These needs are common to most families on small mixed farms in Kenya and elsewhere in medium to high rainfall tropics. Often livestock and crops compete for limited land and labor resources to the detriment of overall productivity of the farming system. In the region of Western Kenya addressed by the SR-CRSP, farm sizes average less than 1 ha, too small to produce feed to support year round lactation by cattle.

The hypothesis being tested is that the resources on these farms can support a dual-purpose goat system involving three or more does bred so that at least one doe is lactating throughout the year. This goat system should provide small quantities of milk for daily family use. Prolific does averaging an eight month parturition interval should each annually produce over 2 kids for sale or herd expansion.

PROGRAM REQUIREMENTS

Although goats are numerous and milk consumption is popular in Kenya there has been little experience milking goats by small farmers. One reason is the lack of goats with good lactation potential adapted to medium to high rainfall areas (1000 mm +). Another limitation is the

production and preservation of sufficient feed for goats without reducing overall food/cash crop productivity on small farms. Even when the feed and goat constraints are resolved, there is a need to package these technologies in low cost, simple interventions acceptable to farmers who have not previously used dual-purpose goats. Nutrition/health management strategies are required for technical feasibility. Social-economic modifications are required for social and economic feasibility.

A farming systems research methodology has been followed by the SR-CRSP in Kenya. The interdisciplinary team of Kenyan and expatriate scientists includes crop and animal scientists, veterinarians, sociologists and economists.

PROGRAM DEVELOPMENT TO DATE

Research started in 1980 with surveys to characterize farming systems in the target region. Component (largely single disciplinary) research started in 1981. Principal on-station activities are based at Kabete Veterinary Research Labs (Health, Systems Analysis), Ol Magogo (Breeding), and Maseno (Health, Sociology, Economics, Production Systems -- Feed Resources, Nutrition/Management). These multiple sites have conferred both advantages in terms of land and facility use and disadvantages from decentralization of scientific team.

The program has steadily developed in terms of activities and accomplishments; however, there have been obstacles to overcome:

1. The principal host country collaborator, Ministry of Agriculture and Livestock Development, has been substantially reorganized twice since 1980; each time leading to an extended period of operational uncertainty.

2. Discovery of a disease (CAE) widespread among American dairy goats led to cancellation of a major importation of seedstock in 1981. Lack of improved dairy stocks needed by Breeding project to develop a new dual purpose line continue to limit evaluation of the feasibility of the improved goat production system.
3. Although MALD has provided strong administrative support and has made available needed research facilities, well trained technical collaborators and funds to meet operational costs have been limited by short supply.

Fortunately good progress has been made in resolving these limitations to program development.

COMMITMENT

SR-CRSP has assigned senior Ph.D. scientists to Kenya and provided funding to meet operational costs. The majority (75% to 90%) of AID funds awarded to U.S. institutions are directly used to support research activities in Kenya. These costs have included purchase of laboratory equipment, computers, livestock, supplies as well as hiring research support staff and meeting operational expenses of MALD technical staff.

Excepting veterinarians, MALD technical staff available for collaboration have generally been recent B.S. level graduates. The SR-CRSP has devoted major resources to training Kenyans to M.S. or Ph.D. level (table 1). Potential for training has been a major incentive supporting recruitment of the better young technicians because they are generally required to serve on the SR-CRSP.

RESEARCH PLAN 1985-1987

Major progress has been made toward describing the requirements for a

successful dual-purpose goat system in terms of feed, health, and labor inputs. Component research has led to meaningful stand-alone accomplishments: development of an effective vaccine for CCPP, introduction of dual-purpose legumes to cropping systems (examples are pigeon peas for food/feed, sesbania for feed/fuel wood), and the determination that consumers accept goat milk just as well as cow milk.

Considerable work remains to incorporate these and other research findings into strategies and technology packages that meet farmers' requirements. Evaluating feasibility of these strategies will involve monitoring large scale on-farm trials managed by the farmers, rather than scientists.

Lack of experimental precision possible with on-farm research requires that many farms will be sampled, especially given the social, cultural, economic, and ecological heterogeneity of the target region. Preliminary plans call for evaluation of dual-purpose goat systems on 250 to 300 farms, placing 3 or more dual-purpose goats on each farm. Evaluation should be for the full goat production cycle (minimum 3-4 years) to ensure that all factors determining feasibility are carefully evaluated.

To date, approximately 100 dual-purpose goats (generally of unknown level of Toggenburg x local breeding) have been placed on farms of cooperators in experiments closely managed by scientists. These experiments have been highly useful in characterizing the constraints to dual-purpose goat production.

However, more and better quality goats of known breeding are needed for on-farm evaluation. The first produce from the breeding project (approximately 120 second parity does) will be place on selected farms in early 1986 (table 2). In addition, feed-nutrition-health-management interventions will be evaluated in conjunction with placement of these goats. All scientists on the team will be involved in planning and implementation of these evaluations, which will also serve as a trial run for the subsequent comprehensive evaluation of dual-purpose goat production systems.

RESEARCH PLAN 1988-1990

Because of the continuing difficulty of importing dairy goats from the United States, bucks will be imported from the United Kingdom in 1985 or early 1986. Breeds will include Toggenburg, Alpine, and Nubian. These bucks will be mated to East African and Galla doe with crossbred offspring used to:

1. develop genetic base from which dual-purpose goat breeds will be developed by Breeding project, and
2. provide approximately 1,000 crossbred does to support large scale on-farm evaluation of dual-purpose goat production systems.

Extension of the SR-CRSP in Kenya through 1990 will be necessary for development of new breeds of dual-purpose goats and for full evaluation and analysis of technical, social, and economic feasibility of dual-purpose goat production systems utilizing dairy x local cross does. The evaluation will be conducted in western Kenya.

Opportunity exists for expansion of dual-purpose goat research to other farming systems in Kenya. After 1987, monitoring of farmer managed trials can largely be accomplished by technicians with scientist supervision. This will free scientist time to initiate additional research at other sites. Considerable interest has already been expressed in transfer of dual-purpose goat technologies to mixed farming systems in Central, Coast, Eastern and Rift Valley Provinces. Generally, these are regions where human populations are growing rapidly and increased emphasis is placed on mixed farming systems to replace nomadic pastoral systems.

Additional opportunities exist to adapt and extend research on dual-purpose goat production systems to humid/subhumid sites in central Africa.

Table 1. SR-CRSP/Kenya training program.

Name	Degree	Subject	University	Date started	Date completed
H. Blackburn*	Ph.D.	Breeding	Texas A&M	1979	1984
M. Job*	Ph.D.	Ag. Eco.	Purdue Univ.	1979	1984
M. Sands*	Ph.D.	Anim. Sci.	Cornell Univ.	1979	1983
A. Aboud*	M.S.	Socio.	Ohio State	1980	1982
J. Bari	M.S.	Health	Washington State	1980	1984
K. Boor*	M.S.	Food Sci.	Univ. Wisconsin	1980	1983
J. Mathenge*	M.S.	Breeding	Texas A&M	1980	1981
D. Mortimer*	M.S.	Ag. Econ.	Washington State	1980	1983
J. Kibuchi*	M.S.	Nutrition	Tuskegee Institute	1981	1982
S. Mbwiria	M.S.	Health	Washington State	1981	1984
A. Ogal*	M.S.	Socio.	Auburn Univ.	1981	1983
A. Okeyo	M.S.	Breeding	Univ. Calif., Davis	1981	1984
C. Suda*	Ph.D.	Socio.	Univ. Missouri	1981	1985
J. Njanja	M.S.	Health	Washington State	1981	1985
S. Waghela	Ph.D.	Health	Washington State	1981	1988
P. Howard*	Ph.D.	Breeding	Texas A&M	1982	1987
M. Matuva	M.S.	Nutrition	Univ. Reading	1982	1983
E. Mukisira	M.S.	Nutrition	Louisiana State	1982	1984
D. Mwamahi	M.S.	Health	Washington State	1983	1986
S. Tallam*	M.S.	Breeding	Texas A&M	1983	1985
C. Ahuya	B.S.	Anim. Sci.	Texas A&M	1984	1985
N. Mbabu	Ph.D.	Socio.	Univ. Missouri	1984	1987
F. Nyaribo	Ph.D.	Ag. Econ.	Washington State	1984	1987
E. Oluoch	M.S.	Health	Washington State	1984	1985
K. Otieno	M.S.	Anim. Prod.	Univ. Reading	1984	1985
M. Salim	M.S.	Nutrition	Texas Tech	1984	1985
R. Shavulimo	M.S.	Health	Washington State	1984	1985
A. Okeyo	Ph.D.	Breeding	Texas A&M	1985	1989

Table 2. Schedule of SR-CRSP research activities in Kenya

		Year						
		80	85	86	87	88	89	90
1.	Characterization of farming systems	-----						
2.	Component research, generally single discipline or research stations.		-----					
3.	Scientist managed on-farm trials using Kenya Toggenburg cross does to evaluate feed, nutrition and health interventions in western Kenya.		-----					
4.	Scientist managed on-farm trials evaluating 120 dual-purpose does from Breeding Project and feed-nutrition-health management packages.				-----			
5.	Farmer managed on-farm evaluation of dual-purpose goat production systems, monitored by interdisciplinary team; analysis to determine technical and socioeconomic feasibility.					-----		

Table 3. Schedule for production and evaluation of dual-purpose goats

1.	Import dairy bucks	Fall 1985
2.	Mating of dairy bucks to local does	Spring 1986
3.	Birth of DPG	Fall 1986
4.	Placement of bred yearling DPG on farms	Fall 1987
5.	Evaluation of first lactation performance and on-farm kid rearing	Spring 1988
6.	Evaluation of rebreeding efficiency, second, and subsequent lactations	Fall 1988 continuing through Fall 1990

Bill Johnson

The Small Ruminant CRSP in Morocco

1. Introduction

Collaborative research between US CRSP and Moroccan scientists was initiated in 1981 in the areas of Range, Sociology and Nutrition, with a Breeding/Reproduction project added in 1982. Collaboration from IAV scientists in other disciplines was initiated in 1984-85, with the addition of a Farming Systems component to the Sociology project; Parasitology, to the Range project; and Environmental Physiology, to the Breeding/Reproduction project.

Both the Range and Sociology projects have concentrated their efforts to date in range production systems, mostly in the Middle and High Atlas, while the Nutrition and Breeding/Reproduction projects have focussed work at IAV's Tadla Farm, representing a mixed crop-livestock production system with a combination of grazing and confinement feeding of harvested forages and by-product feeds. In the first system the work involves both sheep and goats, while in the second the work to date has been with sheep only.

Because of the differences between these two systems and of the importance of both to total sheep production in Morocco, it has been decided in 1985 to formalize the emphasis on the two systems in the Morocco CRSP in the future. Coordinators have been appointed to bring together program participants within each of the two systems, and to coordinate work on development of technology packages suitable for field testing and application. An overall coordinator will continue to provide leadership for the Morocco CRSP as a whole.

The sections which follow present descriptions of the two systems and a short summary of current and projected work in each. Areas of potential complementarity and collaboration between the two are then listed, followed by a general discussion of possible future directions of the CRSP in Morocco.

2. Production Systems

Throughout Morocco, sheep production systems can be classified according to the respective importance of the range forages and farm-produced feeds in meeting the nutrient requirements of animals. We can, therefore, schematically identify two major types of systems:

2.1. SYSTEM 1 in which farming provides an important part of the animals' needs (mixed crop-livestock production system).

2.1.1. Cereal producing Zones

In these zones, the annual ovine feeding calendar can be summarized as follows:

June to October:	stubble
October to January:	straw, concentrated feed and range
January to June:	fallow and range

In this system, sheep production is closely tied to cereal production: lambs benefit from grazing young barley, ewes use stubble and straw; barley grain is used by all of the animals. According to the significance and the quality of the range, its position in the feeding calendar varies.

The practice of fallow grazing is justified by farmers for the maintenance of the level of fertility of the soil and for meeting the animals' needs at the same time.

Concentrated feeds are given especially at the time of lambing and during periods of rain and cold.

Examples of regions: Settat, Casablanca, Tanger, Meknès, Fes, Khemesset, Rommani...

2.1.2. Irrigated Zones

In these regions, the sheep production system can be similar to the preceding if irrigation has not brought about the following modifications:

- The fallow and range have virtually vanished
- Industrial cultivation and planting provide significant quantities of by-products which can be used by sheep: olive foliage, citrus foliage, beet leaves and tops, by-products of market gardening
- cultivated forages exist but are basically reserved for milk cows.

Under these conditions, the feeding calendar for sheep is generally:

June to October:	stubble, by-products, grazing by roadways and canals
October to January:	straw, concentrated feeds, by-products, grazing by roadways and canals
January to June:	transhumance to a range area situated close to an irrigated perimeter

Examples of regions: Tadla, Gharb, Tassaout, Haouz

A notable exception to this system is that of the Ziz and Draa valleys where the ovine feeding calendar scheme is:

February to November:	green alfalfa, straw and by-products
November to February:	alfalfa hay, straw and by-products

In this case, alfalfa replaces fallow, stubble and range at the same time.

2.2. SYSTEM II in which range lands provide for the animals' basic needs year-round.

In this case, small ruminant (goats as well as sheep) production is based, above all, on the range (clear or in forest) which provides for up to 90% of the animals' total requirements per year. The rest of the requirements are met by:

- stubble between June and October
- straw and concentrated feeds between December and March, during lambing/kidding or times of severe cold.

Examples of regions: Middle Atlas, High Atlas, Anti-Atlas, Oriental...

Relative Importance of the Different Systems

Table 1, based on 1982 survey results, gives an idea of the relative importance to Morocco of the previously described production systems. (This relates to sheep; for goats, a higher proportion of animals are found in System II.)

<u>SYSTEM</u>	<u>NUMBER OF HEAD</u> <u>(1000's)</u>	<u>%</u>
System I		
Cereal producing zones	4100	42
Irrigated zones	2100	22
System II	3500	36
	<hr/>	<hr/>
TOTAL	9700	100

This table shows that the cereal producing zones are sustaining more than 40% of the actual total sheep, followed by the regions pre-dominated by range areas and then by the irrigated zones. This distribution should be considered a rough estimate, given the overlap in the majority of the country of production systems I and II, previously defined.

3. Present and Projected Activities

3.1. Mixed crop-livestock production system

3.1.1. Goals and present status

Projects presently involved in this system include Breeding/Reproduction, Nutrition and Environmental Physiology.

The general goals of the program are to develop new knowledge which can be translated into information to increase the efficiency of sheep production within this agricultural system in Morocco.

Specific goals of the Breeding project are:

- 1) to evaluate the potential of sheep carrying varying proportions of inheritance from the prolific D'Man breed, in combination with the larger but less prolific Sardi, for increasing efficiency of sheep production in this system
- 2) to develop information on means of utilizing these sheep effectively in the area, and to carry out field evaluations of the sheep and accompanying production technology.
- 3) A more basic scientific goal of the project is to determine the genetic basis of the exceptional prolificacy of the D'Man.

Goals of the Environmental Physiology component of this project are to quantify physiological differences between the different genetic types, in responses to the wide temperature and humidity variations of the area, and similarly to compare ewes carrying one, two or three lambs. This information can then contribute to development of improved management systems for sheep of different production potential.

Goals of the Nutrition project are:

- 1) to develop information on the feeding value of different forage and by-product feeds of potential use to sheep producers with traditional types of sheep for the area.
- 2) to collaborate in developing efficient feeding programs for sheep of improved genetic potential.

Research with sheep at IAV's Tadla Farm was initiated in 1982. Prior to that time there had been no livestock on this 262 Ha farm, on which the principal crops are wheat, alfalfa and sugar beets. A major emphasis of the Breeding

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project has been development of facilities for a 600-ewe breeding flock; CRSP Prolific Sheep Project and County Work Group Funds have also contributed to this development. In 1984 the first part of the facilities for nutrition studies were completed. These facilities provide for individual as well as group feeding. Extension of these facilities in 1985 will provide the capability for carrying out nutritional trials on a larger scale, using both growing lambs and adult ewes from the breeding project.

By the end of 1985 five lamb crops will have been produced in a 36 month period on an accelerated lambing schedule. The mating plan has been designed to provide for a comparison of animals carrying 0, 25, 50, 75 and 100% prolific breed inheritance. Evaluation of these sheep will contribute to the objectives of the breeding project, and the flock will also provide animals for the proposed field tests. Data from these animals will be used for the dissertations of three doctoral candidates in the Reproduction and Animal Production Departments at IAV.

Data on the performance of the two parent breeds and F_1 crossbred offspring, and on the effects of season/nutrition on reproduction and growth of these sheep are currently being analyzed and prepared for publication. Marked breed differences in degree of seasonality of mating activity and marked seasonal effects on lamb growth rate have been documented. These results will be used in the development of plans for effective exploitation of the different types.

Some data have been recorded on wool production, and animals in the project are scheduled to be used in a study to help define goals for selection for improved wool production of Moroccan breeds. This aspect of the work is expected to have applicability to range production systems as well.

Two surveys of sheep production operations in the Tadla area (dryland and irrigated) have provided information on the importance of sheep in the area, size and structure of flocks, feed resources and feeding systems used, reproductive rates and overall productivity.

The Tadla Farm is the major site for the evaluation of feed resources locally available, which include cultivated forages (alfalfa, clovers), crop residues (straw and stubble) and agro-industrial by-products (beet pulp, citrus pulp, waste palm dates). Some data have been collected on the value for growing animals of mixed rations containing alfalfa and various types and amounts of by-products. This information will provide the basis for improved feeding programs to increase meat production. Publications are now prepared on these topics. Data on nutrient requirements of different breeds of sheep are now being analysed at the ENA Meknès and will be published later.

3.1.2. Expected status of the work in 1987

Completion of facilities, including working corrals and nutrition research pens, is necessary for more intensive research at Tadla Farm.

The Nutrition group will focus efforts on the study of stubble grazing by pregnant ewes during summer. Surveys planned will provide a more complete diagnosis of current practices with regard to use of stubble. Long term and repeated experiments at the Station are needed to develop sufficient understanding of the nutritional contributions and limits of stubble as a feed resource and to come up with practical recommendations for farmers.

Animals from the breeding project will be used in studies of genotype-nutrition interaction. The main factors to be studied include level of intake; diet quality; stocking rate and seasonal effects; influence of grain species, variety and yield; and supplemental strategies.

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By 1987, characterization of the D'Man and Sardi breeds & F_1 crossbreeds should have reached the stage of making recommendations to producers. Based on the estimates of F_1 performance to date, it is planned to initiate field trials with F_1 rams, and these should be underway by 1987.

Detailed evaluation of contemporary purebreds, F_1 's, F_2 's and backcrosses (0, 25, 50, 75 and 100% of each parent breed) will be approaching mid-point, but because of the need to evaluate mature ewe performance, this phase cannot be completed before 1989 or 1990.

Environmental Physiology research on D'Man, Sardi and F_1 ewes will be initiated at Tadla Farm in 1985. By 1987, this should have produced results from that environment, to compare with those previously obtained with Moroccan breeds of sheep in a location with less extreme temperature variation, where breed differences in response to stresses have already been well documented.

The project on nutrient requirements and carcass evaluation of different breeds and crosses, including the D'Man, currently being carried out at ENA, Meknes will be integrated more closely with the Tadla CRSP project beginning in 1985, including exchange of animals. This will provide information on another component of performance of the Tadla Farm animals. Also, ewes of different groups from the Tadla flock may be compared at ENA Meknes in 1986-87, in a terminal crossing program, adding to the information on performance of ewes of different potential in different management systems.

By 1987 two participants in the program, one from the Animal Production Department at IAV and one from ENA, Meknes should have completed doctoral research, based primarily on work at other locations, but also involving CRSP work at Tadla. Several more doctoral candidates from IAV will be in mid to late stages of their doctoral research, based primarily on animals in the CRSP projects at Tadla, and

other third cycle and doctoral students are expected to use Tadla Farm animals. These candidates represent several areas, including Genetics, Reproductive Physiology, Nutrition, Environmental Physiology, Biochemistry and Veterinary Medicine. Thus by 1987 the Tadla research flock will be a major focus of sheep research for IAV.

3.1.3. Expectations if project is continues to 1990

As indicated above, several aspects of the work cannot be completed by 1987. In fact the project has progressed very rapidly, through prompt development of facilities and use of an accelerated lambing schedule. However, breed evaluation and development of new combinations require a minimum of two generations, and estimation of lifetime performance requires at least five years. With the first lamb crop in this research program born in 1983, 1990 is the earliest that a comprehensive evaluation of the different types can be completed.

Several aspects of the Nutrition research program are also long term, requiring repetitions across years for full validation, and thus work toward the current goals will not be complete by 1987. Also, one of the key IAV participants in the Nutrition project will be just returning from the U.S. phase of his graduate training in 1987.

Work to be carried out during the period 1987-1990 would include:

- 1) Completion of the phase II genetic evaluations, and assessment of the basis of inheritance of the D'Man prolificacy.
- 2) The major part of the work on genotype x nutrition/management interaction, to assess the suitability of different types to different management systems.
- 3) Collection of data on reproduction and wool and lamb production on progeny of Tadla Farm rams placed in field tests.

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- 4) Studies of the responses of ewes pregnant with one, two or three lambs, and of growing lambs, to the stresses of high ambient temperatures under different levels of nutrition.
- 5) Evaluation of production technology systems for higher genetic potential sheep under field conditions, involving collaboration of Genetics, Nutrition and Physiology projects and, it is hoped, with input from Economics, Sociology and Parasitology.
- 6) Initiation of selection programs for improving growth and wool traits of existing breeds and improved strains developed in the project.
- 7) Evaluation of stubble as the main source of feed for sheep during gestation and early lactation.
- 8) Nutritive value of some poor quality forages (straw) and good quality forages (alfalfa) produced in the Tadla area.
- 9) Nutritive value of some by-products available in Tadla (caroub, molasses, beet tops and leaves). These data will be used as part of the doctoral thesis of a faculty member in Nutrition.
- 10) Nutrient requirements for growing lambs and ewes during gestation and lactation.
- 11) Carcass evaluation of different breeds under different levels of nutrition
- 12) Fattening rations for lambs
- 13) Field testing of economical feeding schedules based on data collected

3.2. Grazing and rainfed mixed farming system (Middle and High Atlas mountains)

3.2.1. Background and goals

Grazing and rainfed mixed farming are common land use in the Moroccan mountains. These ecosystems represent 35% of the total rangeland of the country, and are the home base of respectively 25% and 35% of the sheep and goat populations recorded in Morocco. Demographic pressure in

these regions and the resulting expansion of cultivation into lands previously devoted to livestock and silviculture are causing overgrazing, loss of vegetation cover and acceleration of erosion processes.

The herd productivity in these mountains is usually low. This is the result of poor nutrition, inadequate husbandry practices and insufficient control of parasites. In addition to these biological constraints, social limitations imposed by the collective nature of land use are worsening this situation. Consequently most pastoralists in these areas are operating at a subsistence level, and their incomes are extremely low.

The Middle Atlas and High Atlas mountains have received in the past different levels of attention from the government of Morocco. While the Middle Atlas has a well established administrative infrastructure and benefitted from several development programs during the last decade, the High Atlas remains an extremely isolated region that has received almost no attention except from a few academic investigators. In both situations, however, the opportunities for improvement and progress are great. The approach to fulfill these opportunities requires the definition of an integrated package of technology adapted to these regions and including recommendations on range development, animal husbandry and animal health practices. In parallel an understanding of the social constraints to the functioning of the pastoral system is needed in order to earn the pastoralists' support for such packages.

Existing programs related to the target system

Disciplines involved in the target system described above include range management, sociology, farming systems and parasitology. The overall research goal of the sub-projects proposed by these disciplines is "to increase small ruminant productivity through an improvement of the

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forage resources and production efficiency." Specific objectives of each subproject are as follows:

Range Management

- a) an ecological assessment of range forage resources, in which the ecological potential for important range sites are being determined, in addition to monitoring of plant community changes in relation to physical environment and land use.
- b) an understanding of plant-animal relationships, including the description of the annual forage cycle and animal feeding behavior, the examination of forage intake in relation to nutritive requirements, and the evaluation of animal performances.
- c) an investigation on range management and improvement techniques, such as the effect of grazing pressure and pattern on the plant community composition and production in addition to the definition of establishment characteristics of selected rangeland plant species.

Sociology

- a) description of the context in which small ruminant producers make decisions about animal production
- b) identification of the role of animal production and its interaction with other activities
- c) evaluation of the effectiveness of traditional Moroccan resource management systems, particularly the "Agdal" pasture reserve system, as a range management tool.

Farming Systems

- a) characterization of the evolution and the actual situation of sheep production in the High Atlas
- b) assessment of the interaction between components of farm systems

- c) definition of sound systems of sheep production and the identification of actions to be demonstrated by extension services for each system.

Parasitology

- a) determination of the parasitic fauna infesting sheep in the Middle Atlas
- b) evaluation of the degree and rate of infestation throughout the seasons
- c) establishment of the parasitic population kinetics and hence the period(s) requiring action for parasitic control in the Middle Atlas.

Accomplishments to date

Since parasitology and farming systems became components of SR-CRSP in Morocco in FY 1984-85, only range management and sociology disciplines will be considered in this section.

Research accomplishments

Field research in Morocco was initiated in 1981-82. In general, the data collected so far led to the basic understanding of the small ruminant production systems operating in the site being investigated. They also allowed to identify some of the biological and social constraints limiting the efficiency of these systems.

More specifically, the Sociology group conducted an exhaustive survey of the Rheraya valley in the High Atlas. The data generated from this survey will allow a thorough description of the agro-pastoral system in use in this region. In addition a study of the transhumance phenomenon was undertaken in order to identify the relative importance and contribution of summer ranges. The biological soundness of the deferment of a portion of these ranges ("agdal") was also examined.

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The Range group on the other hand concentrated its effort in three range sites in the Middle Atlas: the oak woodland (El Hajeb - Ifrane), the mountain grassland (Timahdit) and the sagebrush grassland (Boumia). Data produced by this group allowed an assessment of the ecological and grazing potentials of plant communities investigated. Thus, the seasonal changes in the biomass, nutritional quality and palatability of key plant species were evaluated for the three range sites. In addition, effects of stocking rates and grazing systems on the survival of desirable plant species and animal performances were (or are being) elucidated. Preliminary recommendations could already be drawn from the available data. These recommendations relate to the nature and the period of dietary supplementation of grazing sheep and goats, definition of the proper grazing pressure, indications on grazing plan allowing regeneration of degraded sagebrush sites, and adaptability of different perennial grasses to low rainfall areas.

Institution building

SR-CRSP funds contributed to the equipment of basic laboratories for nutrition and ecophysiology at both IAV Rabat and ENA Meknes. These funds also helped initiate a range experimental station at Boumia. In addition funds allocated by the SR-CRSP permitted the organization of a special session on range problems and research in Morocco at the Second International Rangeland Congress held in May 1984 in Australia. During this session, ten technical papers were presented by American and Moroccan scientists (six of them involved in the SR-CRSP project).

Training

Education was a highly valuable accomplishment of SR-CRSP in Morocco. Two Moroccan faculty participants in the CRSP are completing doctoral research in range with partial support from the CRSP. Three American students

were supported by SR-CRSP to conduct their research in Morocco towards their Ph.D. (1) and MS (2). In addition, the SR-CRSP provided partial support to eight Moroccan students at the MS degree level and 12 at the BS degree level.

3.2.2. Expected status of the program by 1987

During the last three years, the research output was remarkable in the Middle Atlas and the High Atlas sites, as illustrated by the number of publications (10) and student theses (1 Ph.D., 10 MS, and 12 BS).

As we would expect, during this first phase of the project, efforts were primarily discipline oriented. At present, given the amount of baseline information collected, all participants are recognizing the need for more integration among disciplines. In this context the parasitology and range management activities are fully integrated, likewise for sociology and farming systems. Also, toward these ends, the disciplines involved are beginning to develop an adapted package of technology to be used as a pattern by the pastoralists.

3.2.3. Areas of potential collaboration between the Range and Mixed Crop-Livestock Production system components of the Morocco SR-CRSP

The descriptions and plans outlined above emphasize the distinctive features and research needs of the two production systems. However, there are important areas of common interest, and regular communication, with collaboration where appropriate between scientists working in the two systems, is an important goal of the Morocco CRSP.

Some areas of common interest include:

- 1) Information on feeding value of various feedstuffs or combinations of feeds developed at Tadla for the

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crop-livestock production system may be very useful to range production systems where supplements are fed at certain times of the year.

2) The development of a grading system for Moroccan wool and of selection criteria for improvement of fleece quantity and quality should be applicable to both systems.

3) While improved prolificacy is not a goal for the harsher range areas, in the better range areas some increase in twinning may prove to be advantageous (as it has in range areas of other countries). In these situations, use of rams from strains of intermediate prolificacy developed at Tadla could prove to be advantageous.

4) Design and conduct of field tests of improved feeding and management practices and improved genetic stocks in either system will benefit from input from sociologists and economists familiar with the goals and methods of the CRSP.

The SR-CRSP in Morocco Beyond 1987

It is easy to justify continuation of SR-CRSP activities in Morocco beyond 1987, for many of the same reasons that the program was initiated in 1982, and because of progress to date. As indicated in the preceding sections, several aspects of the work underway, by the nature of the work, will require several years to complete. However, the level of the SR-CRSP program beyond 1987 will depend on several unknowns, both internal and external.

Justifications include:

- importance of small ruminants to Moroccan rural economy and food production.
- the potential for extrapolation of data from Moroccan ecosystems to many other countries of North Africa, the Middle East and the Sahel.
- maturity and seriousness of purpose of the Hassan II Institute and ENA Meknes.
- built-in training component, with 3rd cycle thesis students at Rabat and 2nd cycle memoir students at Meknes.

- built-in extension component, with existing formal and informal linkages of Hassan II Institute and ENA with Direction d'Elevage and producer associations.
- built-in international component, with participation of 2nd and 3rd cycle students from a dozen or more countries throughout all of Africa.
- the investment in facilities and laboratory improvement already made by the U.S. and Moroccan institutions, at the Tadla Farm especially but also at Rabat and Meknes, over the 1982-85 period; the return from this investment has just begun to be realized.
- better understanding of the correct research questions has now evolved; more time is needed to generate answers.
- a large investment by other USAID projects (such as the University of Minnesota program) in scientist training is still underway; by 1987-88 many more scientists will be trained to the Ph.D. level and will be available as collaborators. Continued financial support to these well-trained people will yield great rewards for the SR-CRSP, for the Moroccan institutes, and for the individual scientists.

The optimum level of SR-CRSP activity for the 1987-1990 period is more difficult to predict. Certain information, not yet available, will help in this assessment. Some unknowns include:

- overall funding level of the SR-CRSP worldwide after 1987.
- potential success of the new emphasis on developing technology packages for testing in two major ecosystems, launched this year.
- success in forming meaningful linkages with other development projects in Morocco.
- success in attracting new funding from USAID/Rabat or elsewhere.
- finding budgetary flexibility to fund interdisciplinary projects and expand the team of scientists (perhaps to include visiting scientists from outside Morocco).

Based on the situation with regard to each of these points, the optimum program of the SR-CRSP could be fixed at any one of the following alternatives.

1. Major expansion. This will happen only with an infusion of outside funds. Internal funding of the SR-CRSP as it is presently organized will not allow any program expansion, and may not keep up with inflation. However, in other countries participating in the SR-CRSP, there has been significant augmentation of CRSP activities through funds from other sources (U.S.A.I.D. Mission and other agencies), and such opportunities may develop in Morocco also.

2. Stay as we are with about four U.S. institutional projects, each with several Moroccan collaborators. This will be an attractive alternative if the new coordination and technology testing endeavors succeed.

3. Terminate the entire program in 1987. This is the "worst-case" option and hopefully will not come about. Also, if the SR-CRSP funding must be withdrawn for any reason, a concerted effort by all parties should be made to find alternative funds for all productive elements of the program.

SMALL RUMINANT - CRSP
PERU PROGRAM PLAN
1985-87 and 1988-90

I. Analysis of Present Status of the Peru Program

The SR-CRSP Peru working group held a two day seminar in Lima in January 1985 and discussed, among other things, the present status and future of the Small Ruminant Collaborative Research Program in Peru. These meetings were preceded and followed by meetings of the PI's by themselves and with the PI's and the leadership of our principal host country collaborating institution, INIPA. The following represents our assessment of the consensus of those involved in Peru regarding the present state of the program and the priorities for future SR-CRSP activities in Peru.

Each country work group had been asked by the Technical Committee of the SR-CRSP to indicate whether or not their program has reached, or will reach graduate status by 1987. It was the unanimous sentiment of those involved with the Peru program that graduate status would not be possible by 1987 and highly unlikely to be reached by 1990. While much has been accomplished in Peru to date, a great deal remains to be done. A number of important developments are underway which the SR-CRSP could very effectively compliment.

By almost any standard, Peru, along with Kenya, has the fewest resources in the SR-CRSP structure. As a result there are only a few institutions upon which a strong research program could be established. In particular, unlike any other country in the SR-CRSP structure, Peru did not have a centralized animal science research unit which could be directly supported by all of the projects involved. Thus, collaborative relationships were established with universities and researchers in many different parts of the country. The program has been productive in terms of research output, but the lack of a strong central structure has resulted in to a somewhat fragmented effort which the program is now attempting to overcome. The presence of the SR-CRSP in Peru has clearly had a significant impact in strengthening those institutions with which it collaborated. Although there is major effort to consolidate our activities within INIPA, ties to existing collaborators and their institutions will be maintained.

A. Institutional Development

The formal SR-CRSP memorandum of understanding is with INIPA. However to date, in the history of the SR-CRSP in Peru, this has been the least effective collaborative relationship. Most research, training and institutional development programs have been focused primarily on two universities, the National Agrarian University at La Molina (UNA) and the University of San Marcos through IVITA. In the last three years regional universities have also become involved, particularly the University of the Altiplano in Puno (UNTA) and the University of Pedro Ruiz Gallo in Chiclayo (UNPRG). Only modest sums of money have been used to support facility developments at these four institutions. These developments have been largely at two locations: the alpaca research station at La Raya which was badly damaged by an attack by terrorists in

1983 but is now nearly 100% functional, the RIA laboratory at UNA and the veterinary laboratory facilities at IVITA-UNMSM. Most project resources have gone to support collaborative research with Peruvian scientists and to support the training of Peruvian scientists in the U.S. and, on occasion, universities in Peru.

Additional institutional building efforts (in a physical sense) are needed in Peru, particularly in the animal science area. We do not anticipate that large sums of SR-CRSP money will be used for this purpose in the foreseeable future. The needs are simply beyond the resources of the SR-CRSP and research strategies have been developed which can largely accomplish our goals without the immediate need for more sophisticated laboratory facilities.

As we contemplate institution building, the emergence of a national livestock program for Peru proposed by INIPA should be noted. It is anticipated that the SR-CRSP will support the development of this program but it is not yet clear what form this support will take. Technical assistance and training for INIPA staff appears to be the logical course to follow with the present resource limitations rather than the development of physical facilities.

B. Scientific Capabilities

The SR-CRSP has an excellent record of training in Peru. To date, nine Peruvians have completed graduate training in the U.S. Another eight are in process and expect to be completed with their programs by 1986 or 1987. The return of these scientists to Peru has allowed most projects to change their strategy from heavy reliance on expatriate resident scientists to collaborative research with these former students. However, because the trainees are as scattered as the institutions from which they were drawn, this further complicates the problem of consolidating and coordinating research efforts. This will be addressed by the National Livestock Program in INIPA as it attempts to develop a coordinating program for all livestock research activities in the country.

It is noteworthy that all the Peruvians that have completed training in the U.S. have returned to Peru and are actively involved with the SR-CRSP in professional roles. This is particularly noteworthy in view of the completely inadequate salary situation. There is no question in the minds of those involved in the Peru program that the relationship of the Peruvian scientists to the SR-CRSP has been a major positive factor which have kept them involved in their discipline and, in some cases, in the country. The small amounts of resources SR-CRSP can provide for travel, research expenses and other forms of intellectual stimulation have been invaluable in maintaining a cadre of trained animal science specialists in the country under the grave economic problems Peru has faced during the last five years. Such support is beyond the present capability of Peruvian institutions. To precipitously withdraw the SR-CRSP from Peru would almost certainly result in a serious dislocation for those Peruvians who have invested so heavily in the program to date.

INIPA is far from having the necessary critical mass of scientists it needs to effectively conduct a national livestock research program. While this program will rely heavily on university based Peruvian scientists and facilities, a considerably greater cadre of trained specialists in INIPA is needed in order for this program to function effectively. It is anticipated that the SR-CRSP will gradually shift its training emphases away from training scientists at the regional universities to helping INIPA prepare for an expanded role in livestock research. To help cover the shortage of trained personnel, it is expected that the SR-CRSP will establish and maintain a group of approximately four expatriate resident scientists in Peru for the foreseeable future. This group will work with INIPA in the implementation of the national livestock program and help coordinate and integrate the SR-CRSP efforts underway at various locations throughout the country. By 1986 it is anticipated that expatriate support will be provided by the economics, range management, animal breeding and sociology projects.

C. Operating Budget

The SR-CRSP is perhaps the major source of operating funds for livestock research in Peru at the present time. This demonstrates the pivotal role the SR-CRSP has played in maintaining the animal science research specialists who occupy key positions in the Peruvian scientific establishment. Increasingly there have been expressions of interest in livestock research and extension in Peru, both on the part of donor agencies, including USAID, and within the Peruvian governmental structure itself. The National Livestock Program which is just now being launched is one example of this.

D. Operating Procedures

As indicated above, the SR-CRSP is involved with a very complicated situation in Peru, both institutionally and in terms of the systems in which small ruminants are produced. On the institutional level, there was no effective central administrative structure with which we could identify. Therefore, the decision was made by all projects to develop relationships with university faculty, even though this meant working in multiple institutions at various locations throughout the country.

In addition, there was a segregation of work between the biological sciences and the social sciences because of some of the unique features of Peruvian agriculture. The biological science work has focused primarily on the large cooperative enterprises which were a product of the Agrarian reform of the early 1970's with less emphasis on smaller producer units. By contrast, much of the social science work has been undertaken in the Peruvian communities. These are a unique form of social organization which date back to pre-Incan times and combine elements of communal production with private enterprise. The decision of the biological scientists to focus their work on the large cooperative enterprises was a wise one as it would be nearly impossible to conduct controlled biological experiments in the community context.

However, the attention of all projects is being focused on the community production system and during the last two years there has been a serious attempt to undertake an interdisciplinary systems project in two Andean communities. During the next year, it is anticipated that some of the promising production strategies which have been successful in the large cooperatives will be adapted, tried and evaluated in the peasant communities.

Institutionally, many changes are also underway. INIPA has been receiving major support from AID and other donor agencies and is now a considerably stronger and more viable organization than it was in 1980. The Peru work group has committed itself to supporting this development through technical assistance and training as it is considered to be the most effective way to integrate the multiplicity of small ruminant research programs in Peru. INIPA is also charged with the leadership of extension programs in Peru. If we are successful in strengthening their capability, we should have a mechanism in place to transfer the technologies which are being developed far beyond the limited boundaries which we could manage within the resources of the SR-CRSP.

E. Progress in Collaborative Research

There have been a number of modest efforts in collaboration and two rather large efforts. The range management and economics projects have collaborated on an effort to evaluate the economic viability of range interventions in the context of a large cooperative enterprise. In addition, the sociology project and the animal health project have plans to evaluate the animal management factor in controlling disease. Other efforts include those being made by individual disciplines working with smaller livestock producers. These are demonstrating some success.

However, these efforts are minuscule compared to the investments that have been made in both time and money in the collaborative efforts which have been initiated in both the northern coastal areas of Peru and in the central and southern highland communities.

The northern goat project was the first effort in Peru to develop a truly collaborative project. It was funded from a special grant from the SR-CRSP contingency funds and involved all of the projects in Peru. Recently it has been sustained through a grant from the IDRC (Canada). While direct SR-CRSP involvement has declined to a minimal level, it is fair to say that the SR-CRSP had a significant impact on the development of this program. Range management and reproduction projects continue substantial research in that region.

More recently, the SR-CRSP has launched an interdisciplinary effort to develop strategies and technologies to improve livestock production in two Andean agro-pastoral communities. Andean communities are unique in structure and present special challenges for researchers in the entire global CRSP program. The strategy employed to date is to form interdisciplinary teams whose members live and work in the community over an extended period of time and assist the community with all aspects of their agricultural production. During 1985-86 it is planned

to move from the collection of baseline data to the actual implementation of some improved techniques for livestock production and pasture management. It is hoped that during the next two years a strategy for transferring new technology to communities can be developed and a number of different technologies tested for their applicability in this unique setting.

II. General Programs Plans 1985-87

As indicated in the foregoing section, the SR-CRSP has had a major impact in Peru, but much remains to be done in institution building, training, integrated development of "technology packages" applicable to smallholder livestock production, and basic research. The first five years of the program resulted in the development of inter-institutional and interpersonal linkages, identification of research sites and strategies, and training of some key personal. Analysis of progress to date and future needs of the SR-CRSP in Peru points to a continuing need for disciplinary and interdisciplinary research in-country and degree oriented training, with emphasis on an integrated approach aimed at the development and validation of "technology packages" or "recommended practices" capable of increasing livestock production at the smallholder or community levels.

A. Integrated Approach to Community Development

Approximately 65% of Peruvian peasant food producers live in Andean communities, yet they do not produce a proportionate share of the output. The larger, better organized, enterprises which comprise the remaining 35% of the population produce proportionately more meat, milk and fiber. This is undoubtedly due to a number of reasons, not the least of which is the better resource base from which the large enterprises operate, but also from the absence of technology specifically applicable to Andean communities. A decision has been reached to build upon the base of experience with "community-oriented" research during the first five years of the CRSP in Peru. We plan to use country development funds as well as funds from individual project budgets to continue the interdisciplinary work already initiated at communities identified in the central and southern Sierra. The work will be coordinated by the Site Coordinator's office and the sociology project. Emphasis will be placed on the development and testing of an ensemble of practices and procedures from each discipline in the SR-CRSP which have potential for increasing livestock production. These components of the "technology packages" must fulfill four criteria: They must be 1) technologically feasible, 2) economically beneficial, 3) socially viable and 4) culturally acceptable. Mixed agro-pastoral and livestock oriented communities in the central and southern Sierra in Peru have been selected for these studies. Baseline production data already collected and the associated parameters that have been described will provide the basis and a perspective in the initiation of some technology transfer trials during 1985-86.

B. Training

In view of the shortage of agricultural scientists in Peru, training must remain a high priority for future SR-CRSP activities. Training programs will consist of the following:

1. Degree oriented programs - Students presently in the U.S. will complete their programs as planned and new students will be recruited for M.S. and Ph.D. programs. Some emphasis will shift to upgrading the capabilities of INIPA.
2. In-country continuing education - Short courses, seminars and other programs have been an integral part of the SR-CRSP in Peru in the past and will be continued and expanded where possible.
3. International outreach programs - The SR-CRSP in Peru plans to increase its regional impact through two primary means: (a) participating in the sponsorship of international conferences such as the International Conference on Camelids in Cusco, June 1985, and the Latin American Association of Animal Production meetings in Mexico in October, 1985, and (b) establishing relationships with agricultural research and extension agencies of other Andean countries to determine agendas of mutual interest.

The ecological zone typified by the high Andean region of Peru extends along the Andean mountain chain from Ecuador to Bolivia and Chile. There are similar ecological areas in the world that should benefit from the SR-CRSP working in Peru. The program in Peru will emphasize publication of information in both Spanish and English and the distribution of this material. Plans are developing for SR-CRSP workshops for the benefit of personnel from other Andean countries. Support for these workshops will be requested from other donor agencies. Other opportunities for training with the SR-CRSP institutions and programs in Peru and participating U.S. universities and institutions will be developed.

III. Individual Project Work Plans 1985-87

The following section represents a synthesis of the general areas of emphasis of each SR-CRSP component project for the 1985-87 period. Integrated, centrally managed projects are not included.

A. Animal Health--Colorado State University

No major changes in emphasis for this project are planned for 1985-87. At CSU, research on methods to diagnose and control sheep pulmonary adenomatosis and neonatal enteritis will be continued. The two Peruvian Ph.D students conducting research in these areas expect to complete their programs by 1987. Field research in Peru on these same problems will be continued and expanded. Additionally, increasing emphasis will be placed on identification of control strategies for disease conditions

that constrain livestock production in Andean communities. In the Department of Puno the animal health effort will be supplemented by a research/development project funded by the World Bank.

B. Animal Breeding -- Montana State University

This project will continue to develop the basic information upon which plans for a national animal breeding program to improve sheep and alpaca can be structured within INIPA's National Livestock Program. Emphasis will be placed on continued development of applicable procedures to more effectively utilize the genetic resources of these species at production levels that are compatible with the environment. This will be done by initiating improvement programs directly with Criollo animals in the communities and by the transfer of genetic material from the improved breeding flocks established on the large enterprises and institutional farms. The broad objective is to improve the production of Criollo animals and to enhance the genetic merit of the primary breeding flocks. Procedures include the widespread application of performance test procedures, and improvement in the accuracy and intensity of selection for traits that have high relationship to, or which are direct measures of, fiber and meat production, reproductive performance, and overall profitability. The research now underway will continue with INIPA, the universities (cooperating with one or more SAIS) and with the research stations at Chuquibanbilla and La Raya. Training in genetics and animal breeding specifically, and in animal husbandry generally, will be provided to promising students within the limits of project resources. In Peru training will continue at UNA. More advanced graduate study will be made available to selected students at Montana State University or other appropriate U.S. universities.

C. Rural Sociology -- University of Missouri

It is anticipated this project will undergo a significant change in emphasis during the 1985-87 period. During 1980-84 the project conducted a great deal of research in Andean communities largely through the efforts of its own staff and was only modestly supplemented by the efforts of Peruvian collaborators. One of the distinct features of this project was that it never firmly established a sound institutional base in Peru which was of concern to all those involved with it. However, a major change was made in 1984 when INIPA made the decision to establish a social science research component with economists and sociologists. A counterpart sociologist has been hired in INIPA and the project is now actively supporting her efforts.

For the 1985-87 period it is anticipated that the project will continue to support the development of a social science research component in INIPA, and training and technical assistance efforts will be focused on this goal. It is anticipated that an expatriate sociologist will be located in Peru to help coordinate the studies being planned by INIPA and to help provide leadership for the community project activities. It is also anticipated that training efforts will be focused on upgrading INIPA's capabilities with the primary

counterpart going for graduate level training at the University of Missouri sometime in 1986.

D. Range and Forages Program -- Texas Tech University

The TTU project will continue grazing management and animal nutrition research presently underway. Several grazing studies in the Central and Southern Sierra will conclude during the 1985-87 period, and no other long-term studies will be implemented. The long-term grazing trial now underway at Manco Capac will continue. Major efforts will be expended to consolidate information from the range and forages work being completed now, in order to develop recommendations for further validation studies. A limited number of short-term studies in goat nutrition and management will continue on the North Coast. Degree-training for three Peruvian graduate students in the U.S. will continue, with additional students becoming involved as funds are available. Continued collaboration with the Winrock Economics and the Texas A & M systems projects is a high priority. A shift in emphasis is planned to allow the placement of an expatriate range scientist to assist in development of INIPA's National Livestock Program, and adapt research findings to community projects, if funds are available. This scientist would have a major responsibility for integrating range management and other CRSP disciplines in situ in Andean communities.

E. Animal Reproduction -- Utah State University

Major changes in emphasis are not anticipated during this project. The collaborative efforts with INIPA, IVITA-UNMSM, UNA, UNTA-Chuquibambilla and the private producers will be continued. The institutional building efforts will continue and be expanded (1) by encouraging and assisting in the development and establishment of collaborative reproduction related research infrastructure, (2) through continued graduate training in U.S. universities (M.S. and Ph.D.) and degree and non-degree training in Peru, and (3) through assisting in institutionalizing research and related programs, data analysis and publication of results. The evaluation of the reproductive and productive capabilities of sheep, goats and cameloids under different environmental conditions and management schemes will be further emphasized. Field testing application of management practices designed to improve production by producers with severely limited resources will be expanded using private producers in communities associated with SAIS' and through collaborative multidisciplinary programs such as community projects.

These reproduction related programs are designed to support INIPA in developing and implementing a national livestock program to improve production at all producer resource levels.

F. Agricultural Economics - Winrock International

Both the emphasis as well as level of effort for this project will change substantially during 1985-87. Institutional emphasis from 1980-84 has focused almost exclusively on the Department of Economics and

Planning at the National Agrarian University. This has been a productive relationship with more than a dozen Peruvian students receiving training and support for undergraduate and graduate degrees and good collaborative efforts underway in support of research with the cooperative sector sheep units, the northern region goat project and the community projects. By early 1986, both our UNA collaborators will be starting PhD programs in the U.S. and program emphasis will be shifted towards training and research support for INIPA staff. Work with INIPA will emphasize getting junior staff involved in field research activities through the SR-CRSP, providing support to the National Livestock Research Program and providing three months per year (on a consultancy basis through IICA) of services to the National Agro-Economic research program being started in INIPA.

This will require the placing of a senior research economist in INIPA during early 1985 for the duration of the SR-CRSP. The staff member will arrive in April. The program will thus gradually evolve from one which emphasized outposted staff and Peruvian counterparts working on discrete research projects of particular interest to the individuals involved to one where the outposted scientist will provide broad support in training, research design and planning and assistance with conduct of research programs that fit into INIPA's major thrusts. Work at UNA will continue at a lower level and will consist primarily of working with graduate students on thesis topics.

Research and training efforts will have a farming systems research focus with emphasis on screening and evaluating promising technologies at the producer level. This work will build upon the framework established in the joint research with Texas Tech and Montana State and will extend this to reproduction and animal health.

IV Justification for 1988-90 Extension of the SR-CRSP in Peru

Poverty not only continues to have devastating effects on the rural and urban populations of Peru, but it has had serious negative consequences for the institutions with which we work and for agricultural development generally. Much of the agricultural infrastructure which existed prior to 1968 was severely eroded by 1979-80. The economic status of the country during the intervening years has made it essentially impossible to rebuild the institutions to carry out agricultural research and development needed by the country.

INIPA in the Ministry of Agriculture is relatively young, having been reestablished in 1978. During the first six years of the SR-CRSP involvement in Peru INIPA had no formal livestock programs. During this period the SR-CRSP has assisted in filling this serious void so far as small ruminants were concerned. Recently, through direct support from USAID/Lima, and some involvement of SR-CRSP, INIPA made a detailed study of livestock program needs for the country and the basic framework for a national livestock program was developed. Continuing assistance for the successful initiation and development of Peru's National Livestock Program is necessary. The SR-CRSP can provide essential support through information, continued presence of Principal Investigators, and the continuation of research programs.

The universities that relate directly to agriculture, and specifically to small ruminants, have great need to strengthen their research and teaching capacity. The most effective way this can be done is through training young personnel. National resources with which to carry out these important teaching and research functions are limited. The SR-CRSP, which contributes through training and direct support of research, has had a stabilizing influence on the university involvement in small ruminant research. Most Peruvian counterpart scientists are university employees and have continued with the program since its inception. There is enthusiasm for the program by Peruvian counterparts and by USAID/Lima. The training process and collaborative research through the SR-CRSP should be continued. A basic level of program support is essential to insure that young scientists are able to use their training to contribute to the agricultural development of their country.

V. Program Plans 1988-90

Three principle areas of continuing activity will constitute the SR-CRSP program in Peru during the three year period 1988-90: 1) training and institution building, 2) technology transfer to community and limited resource farmers, and 3) disciplinary or line research.

Training will have a strong emphasis. This will include the training of scientists, technicians and field support personnel in the relevant disciplines. Training of scientists at the Ph.D and M.S. levels will take place, for the most part, at U.S. universities to ensure a new and broader prospective for the younger personnel involved. Training of personnel in the Peruvian universities will continue at the highest level possible. Training capability of the Peruvian universities should be materially improved by 1990. The SR-CRSP will provide "on-the-job" research experience for trainees who in turn will provide needed human resources for the program. The development of training centers by INIPA for extension personnel, technician and field support personnel will be encouraged and supported to the greatest extent possible by the SR-CRSP.

Emphasis on better understanding of Andean communities and their people with respect to the introduction and testing of new technologies will be a major research and development component of the program. Efforts will be directed toward putting in place animal production models (methodology and technology) that have been studied and validated at research stations and large enterprises. Such technology will be incorporated only after careful analysis of the entire farming system of diverse communities has been made. Training at the community level will be a part of the community program effort to increase understanding and awareness of the community leaders regarding the potential benefits of adopting improved livestock production practices. The broad question of technology acceptance by communities and individuals is, in itself, a researchable problem and knowledge acquired through the community program will provide useful information to assist in the basic problem of rural community development worldwide. Disciplinary or line research will be continued but will emphasize interdisciplinary approaches to produce the management technology required to improve Andean small ruminant

production. Research will be continued in each of the disciplinary areas currently involved: range management, forage production and nutrition; animal health; breeding and genetic improvement; animal reproduction; economics; and sociology.